

[CLAIMS]

[Claim 1] A clay-polyurethane nanocomposite comprising a clay and a polyurethane covalently bonded to the surface of the clay wherein the polyurethane is formed by reacting a clay-containing diisocyanate compound with a polyol, the clay-containing diisocyanate compound contains a diisocyanate compound covalently bonded to surface silanol groups of the clay and 0.5~5% by weight of the clay based on the diisocyanate compound, and the clay is exfoliated by the polyurethane such that no wide-angle X-ray diffraction (WAXD) peak is detected between 2° and 10° by XRD measurement.

[Claim 2] The clay-polyurethane nanocomposite according to claim 1, wherein the diisocyanate compound is polymeric-MDI, monomeric MDI, or TDI.

[Claim 3] The clay-polyurethane nanocomposite according to claim 1, wherein the clay is montmorillonite, bentonite, hectorite, fluorohectorite, saponite, beidelite, nontronite, stevensite, vermiculite, volkonskoite, magadite, kenyalite, or a derivative thereof.

[Claim 4] The clay-polyurethane nanocomposite according to claim 1, wherein the clay is treated with an acid, an alkyl ammonium, or an alkyl phosphonium.

[Claim 5] The clay-polyurethane nanocomposite according to claim 1, wherein the polyol is prepared by polymerization of: ethyleneglycol, 1,2-propaneglycol, 1,3-propyleneglycol, butyleneglycol, 1,6-hexanediol, 1,8-octanediol, neopentylglycol, 2-methyl-1,3-propanediol, glycerol, trimethylolpropane, 1,2,3-hexanetriol, 1,2,4-butanetriol, trimethylolmethane, pentaerythritol, diethyleneglycol, triethyleneglycol, polyethyleneglycol, tripropyleneglycol, polypropyleneglycol, dibutyleneglycol, polybutyleneglycol, sorbitol, sucrose, hydroquinone, resorcinol, catechol, bisphenol, or a mixture thereof; and ethylene oxide, propylene oxide, or a mixture thereof.

[Claim 6] The clay-polyurethane nanocomposite according to claim 1, wherein polyol is prepared by polymerization of: phthalic anhydride or adipic acid; and ethylene oxide, propylene oxide, or a mixture thereof.

[Claim 7] The clay-polyurethane nanocomposite according to claim 1, wherein the clay-containing diisocyanate compound shows a peak characteristic to the isocyanate group by infrared spectroscopy, after being washed with dimethylformamide.

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[Claim 8] The clay-polyurethane nanocomposite according to claim 1, wherein the clay-polyurethane nanocomposite further comprises a foaming agent and has a tensile strength a minimum of 10% higher than that of a pure polyurethane foam with the same density by the use of the same foaming agent in the same amount as the clay-polyurethane nanocomposite.

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[Claim 9] The clay-polyurethane nanocomposite according to claim 8, wherein the clay-polyurethane nanocomposite further comprises a foaming agent and has a compressive strength a minimum of 10% higher than that of a pure polyurethane foam with the same density by the use of the same foaming agent in the same amount as the clay-polyurethane nanocomposite.

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[Claim 10] The clay-polyurethane nanocomposite according to claim 8, wherein the foaming agents is selected from the group consisting of cyclopentane, chlorofluorocarbon, hydrochlorofluorocarbon, hydrofluorocarbon, water, and mixtures thereof.

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[Claim 11] The clay-polyurethane nanocomposite according to claim 1, further comprising a diol, a triol, a tetraol, a diamine or an aminoalcohol as a chain extender.

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[Claim 12] The clay-polyurethane nanocomposite according to any one of claims 1 to 11, further comprising a flame retardant, a cell stabilizer, or a mixture thereof.

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[Claim 13] A method for preparing a clay-polyurethane nanocomposite, comprising the steps of:

- (a) mixing a diisocyanate compound with a clay;
- (b) stirring the mixture to form covalent bonds between the diisocyanate compound and silanol groups of the clay; and
- (c) mixing the covalently bonded structure with a polyol and reacting the

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mixture with stirring.

[Claim 14] The method according to claim 13, wherein the diisocyanate compound is polymeric-MDI, monomeric MDI, or TDI.

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[Claim 15] The method according to claim 13, wherein the clay is present in an amount of 0.5~5% by weight, based on the diisocyanate compound.

10 [Claim 16] The method according to claim 13, wherein steps (a) and (b) are carried out in the range of 25 to 80°C.

15 [Claim 17] The method according to claim 13, wherein, in step (b), the mixture of step (a) is stirred at 50~500 rpm for 10~60 minutes, followed by additional stirring at 1,000~4,000 rpm for 2~24 hours.

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[Claim 18] The method according to claim 13, wherein the reaction of step (c) is carried out at 5~40°C.

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[Claim 19] The method according to claim 13, wherein the ratio NCO/OH in step (c) is in the range of from 1.0/1.0 to 1.5/1.0.

25 [Claim 20] The method according to claim 13, wherein the reaction of step (c) is carried out in the presence of a catalyst selected from pentamethylenediethylentriamine, dimethylcyclohexylamine, tris(3-dimethylamino)propylhexahydrotriamine, triethylenediamine, and mixtures thereof.

30 [Claim 21] The method according to claim 13, further comprising the step of sonicating the covalently bonded structure, after step (b), to improve the formation efficiency of covalent bonds between the diisocyanate compound and the silanol groups of the clay and the dispersability between the diisocyanate compound and the clay.

35 [Claim 22] The method according to claim 21, wherein sonication is performed at a frequency not greater than 200 kHz and 5~80°C for 5~60 minutes.

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[Claim 23] The method according to claim 21, further comprising the step of adding a foaming agent during polymerization of the diisocyanate compound and the polyol after the sonication, and reacting the resulting mixture with stirring.